

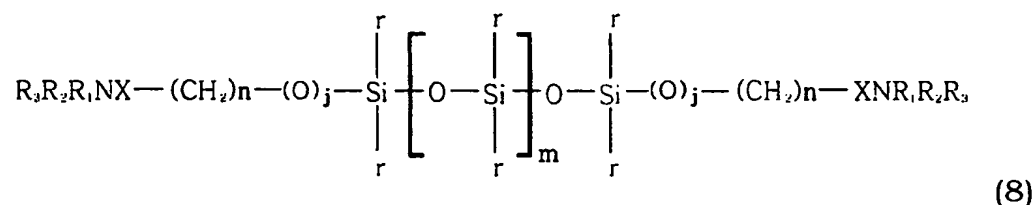
WHAT IS CLAIMED IS:

1. A composition for preparing a porous dielectric thin film which comprises:

(1) a pore generating material of gemini detergent represented by the formula (8), quaternary alkyl ammonium salt represented by the formula (9) or a mixture thereof;

(2) thermo-stable organic or inorganic matrix precursor; and

(3) a solvent for dissolving both the said material and/or salt and the matrix precursor:



j is 0 or 1;

n is an integer from 1 to 12; and

m is an integer from 0 to 10, and



wherein,

N is a nitrogen atom;

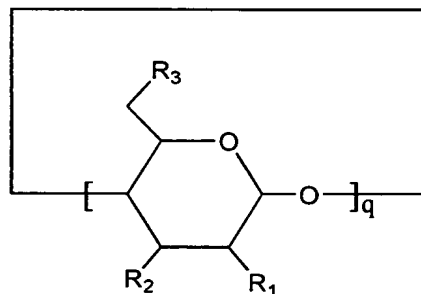
X is a halogen atom; and

L₁, L₂, L₃, and L₄ are independently a C₁₋₃₀ alkyl group.

2. The composition according to claim 1, wherein the content of the pore-generating material is 0.1~95 wt.% of the solid components (the pore-generating material + the matrix precursor).

3. The composition according to claim 1, wherein the content of the solvent is 20.0~99.9 wt.% of the composition (the matrix precursor + the pore-generating material + the solvent).

4. The composition according to claim 1, wherein the pore-generating material further comprises a cyclodextrin derivative represented by the formula (12).



[12]

wherein,

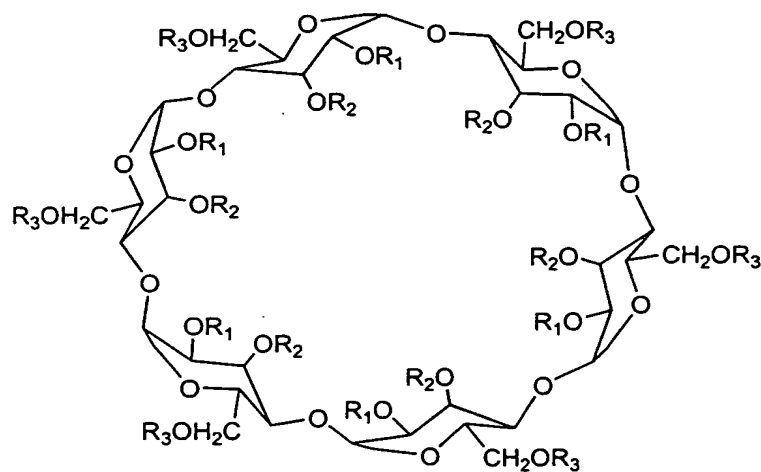
q is an integer ranging from 6 to 12;

R₁, R₂ and R₃ are independently a halogen atom, a C₀₋₁₀ amino group or a azido group, a C₃₋₂₀ imidazole group or a pyridino group, a C₁₋₁₀ cyano group, a C₂₋₁₀ carbonate group, a C₁₋₁₀ carbamate group or a functional group represented by -OR₄, wherein

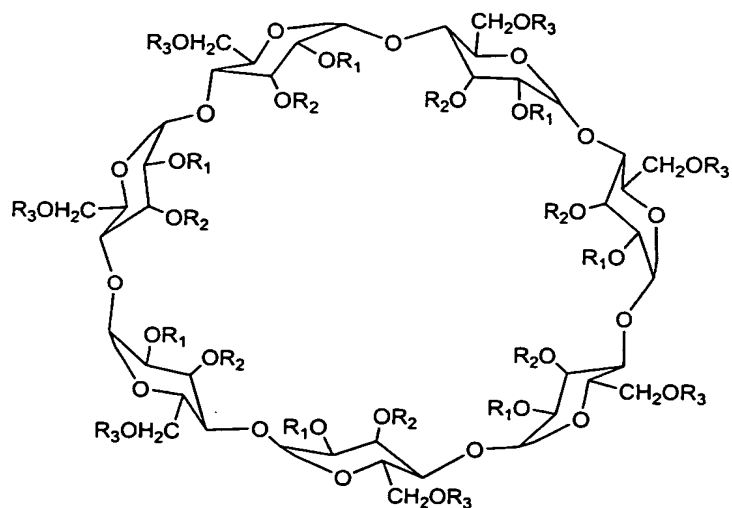
R₄ is a hydrogen atom, a C₂₋₃₀ acyl group, a C₁₋₂₀ alkyl group, a C₃₋₁₀ alkene group, a C₂ alkyne group, a C₇₋₂₀ tosyl group, a C₁₋₁₀ mesyl group, a C₀₋₁₀ phosphorous group, a C₃₋₁₀ cycloalkyl group, a C₆₋₃₀ aryl group, a C₁₋₂₀ hydroxy alkyl group, a carboxyl group, a C₁₋₂₀ carboxy alkyl group, a glucosyl group or a maltosyl group, or silicon compounds

represented by $\text{Si}r_1r_2r_3$, wherein r_1 , r_2 and r_3 are independently a C_{1-5} alkyl group, a C_{1-5} alkoxy group, or a C_{6-20} aryl group.

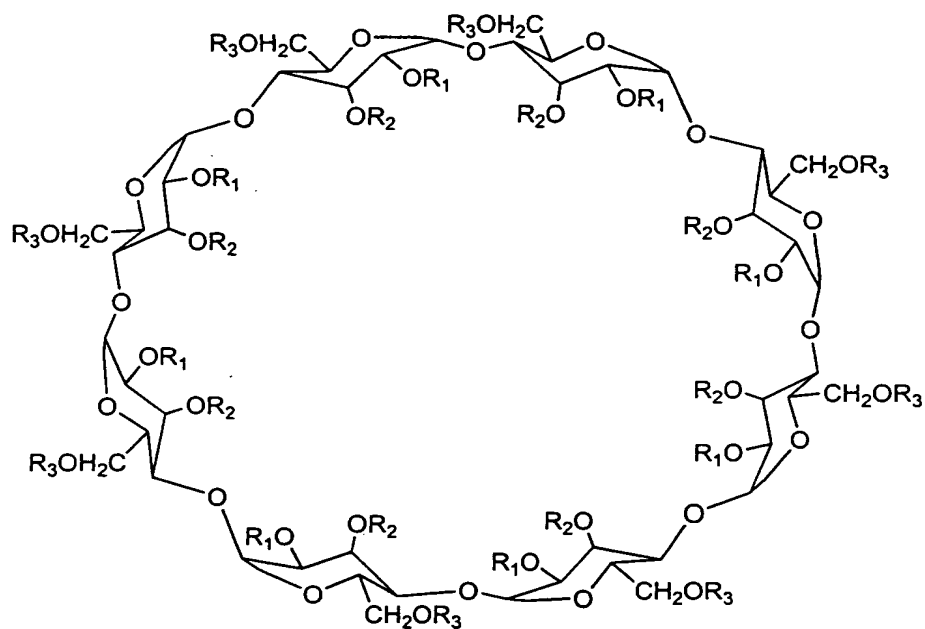
5. The composition according to claim 4, wherein the cyclodextrin derivative is selected from the group consisting of α -, β - or γ -cyclodextrin derivatives represented by the formulae (13) to (15):



(13)



(14)



(15)

wherein,

R_1 , R_2 and R_3 are independently a halogen atom, a C_0 -10 amino group or a azido group, a C_3 -20 imidazole group or a pyridino group, a

C₁₋₁₀ cyano group, a C₂₋₁₀ carbonate group, a C₁₋₁₀ carbamate group or a functional group represented by -OR₄, wherein

R₄ is a hydrogen atom, a C₂₋₃₀ acyl group, a C₁₋₂₀ alkyl group, a C₃₋₁₀ alkene group, a C₂ alkyne group, a C₇₋₂₀ tosyl group, a C₁₋₁₀ mesyl group, a C₀₋₁₀ phosphorous group, a C₃₋₁₀ cycloalkyl group, a C₆₋₃₀ aryl group, a C₁₋₂₀ hydroxy alkyl group, a carboxyl group, a C₁₋₂₀ carboxy alkyl group, a glucosyl group or a maltosyl group, or silicon compounds represented by the formula Si_rr₁r₂r₃, wherein r₁, r₂ and r₃ are independently a C₁₋₅ alkyl group, a C₁₋₅ alkoxy group, or a C₆₋₂₀ aryl group.

6. The composition according to claim 4, wherein the content of the cyclodextrin derivative is 5~95wt.% of the total pore-generating material.

7. The composition according to claim 1, wherein the quaternary alkyl ammonate is selected from the group consisting of tetramethylammonium bromide, tetraethylammonium bromide,

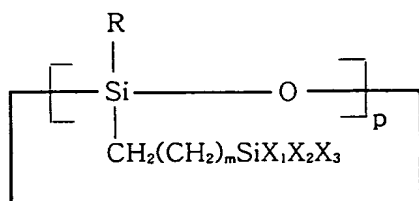
tetrapropylammonium bromide, tetrabutylammonium bromide, tetrapentylammonium bromide, tetrahexylammonium bromide, tetraheptylammonium bromide, tetraoctylammonium bromide, tetrahexadecylammonium bromide, tetraoctadecylammonium bromide, diethyldimethylammonium bromide, dipropyldimethylammonium bromide, dibutyldimethylammonium bromide, dipentyldimethylammonium bromide, dihexyldimethylammonium bromide, diheptyldimethylammonium bromide, dioctyldimethylammonium bromide, and didecyldimethylammonium bromide.

8. The composition according to claim 1, wherein the matrix precursor is selected from the group consisting of silsesquioxane, a alkoxysilane sol and a siloxane-based resin.

9. The composition according to claim 8, wherein the silsesquioxane is selected from the group consisting of hydrogen silsesquioxane, an alkyl silsesquioxane, an aryl silsesquioxane, and a

copolymer thereof.

10. The composition according to claim 1, wherein the matrix precursor is siloxane-based resin which is prepared by hydrolysis and polycondensation of at least one monomer selected from the group consisting of compounds represented by the following formulas (1) to (4) in an organic solvent in the presence of a catalyst and water:



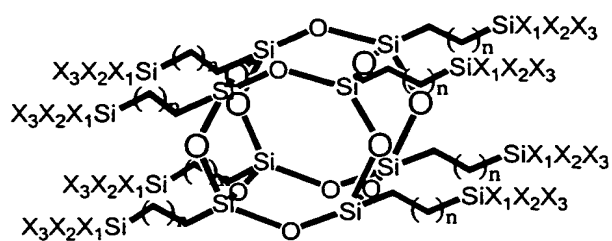
(1)

wherein,

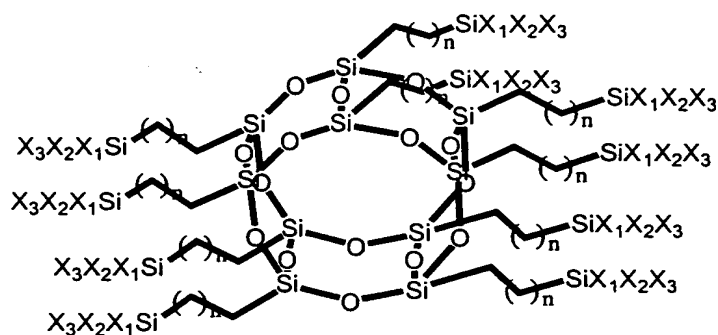
R is a hydrogen atom, a C₁₋₃ alkyl group, a C₃₋₁₀ cycloalkyl group, or a C₆₋₁₅ aryl group;

X₁, X₂ and X₃ are independently a C₁₋₃ alkyl group, a C₁₋₁₀ alkoxy group, or a halogen atom; at least one thereof being hydrolysable; and

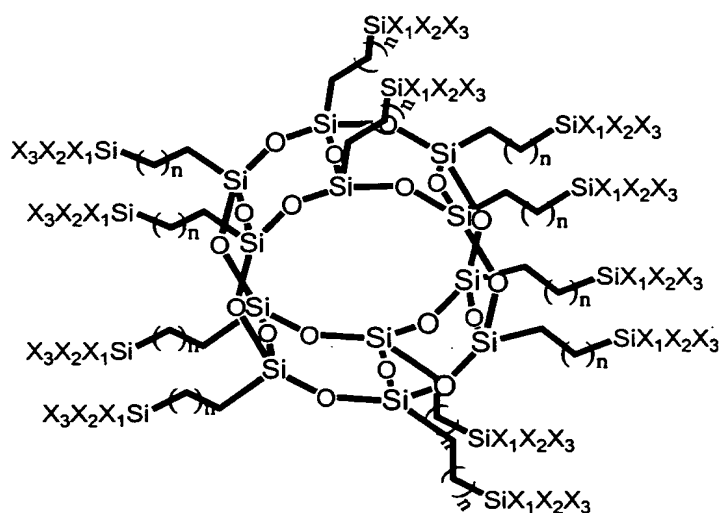
p is an integer from 3 to 8; m is an integer from 0 to 10, and



(2)



(3)



(4)

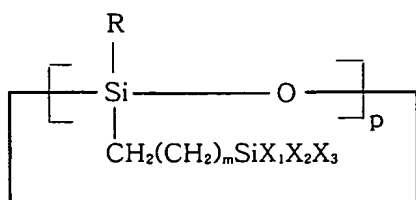
wherein,

R is a hydrogen atom;

X_1 , X_2 and X_3 are independently a hydrogen atom, a C_{1-3} alkyl

group, a C₁₋₁₀ alkoxy group, or halogen atom; at least one thereof being hydrolysable and n is an integer from 1 to 10.

11. The composition according to claim 1, wherein the matrix precursor is siloxane-based resin which is prepared by hydrolysis and polycondensation of at least one monomer selected from the group consisting of compounds represented by the following formulas (1) to (4) together with at least one silane-based monomer selected from the group consisting of compounds represented by the following formulas (5) to (7) in an organic solvent in the presence of a catalyst and water:



(1)

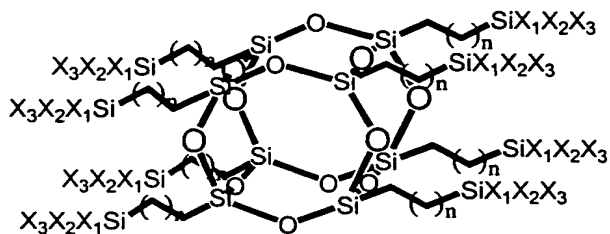
wherein,

R is a hydrogen atom, a C₁₋₃ alkyl group, a C₃₋₁₀ cycloalkyl group, or a C₆₋₁₅ aryl group;

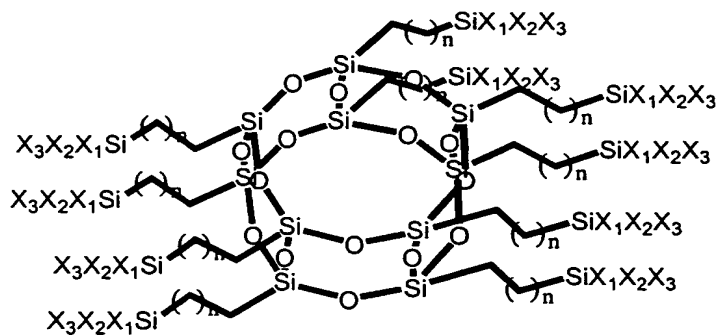
X₁, X₂ and X₃ are independently a C₁₋₃ alkyl group, a C₁₋₁₀ alkoxy group, or halogen atom; at least one thereof being hydrolysable;

p is an integer from 3 to 8; and

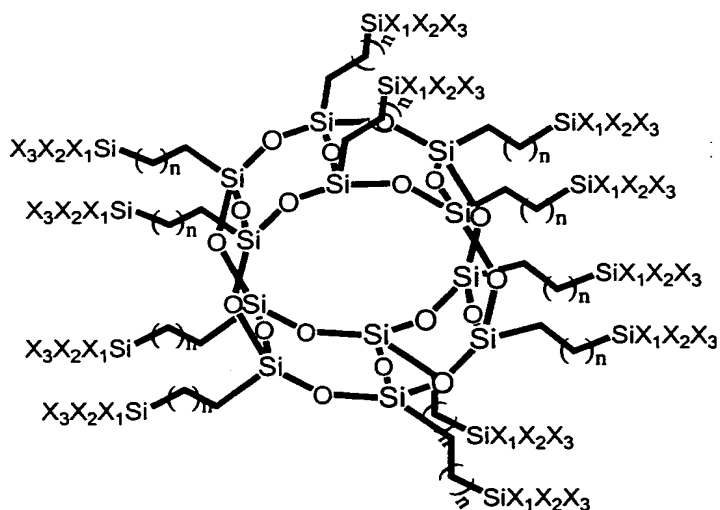
m is an integer from 0 to 10, and



(2)



(3)



(4)

wherein,

X_1 , X_2 and X_3 are independently a hydrogen atom, a C_{1-3} alkyl group, a C_{1-10} alkoxy group, or halogen atom; at least one thereof being hydrolysable;

n is an integer from 1 to 10, and



wherein,

R_1 and R_2 are independently a hydrogen atom, a C_{1-3} alkyl group, a C_{3-10} cycloalkyl group, or a C_{6-15} aryl group;

X_1 , X_2 and X_3 are independently a C_{1-3} alkyl group, a C_{1-10} alkoxy group, or a halogen atom.

12. The composition according to claim 10, wherein the content of Si-OH of the matrix precursor is more than 10 mol%.

13. The composition according to claim 11, wherein the content of Si-OH of the matrix precursor is more than 10 mol%.

14. The composition according to claim 11, wherein the mole ratio of siloxane monomers having cyclic or cage structure to the silane-based monomers is 0.99:0.01~0.01:0.99.

15. The composition according to claim 1, wherein the matrix precursor is a polyimide, polybenzocyclobutene, a polyarylene, or a mixture thereof.

16. The composition according to claim 1, wherein the solvent is selected from the group consisting of an aromatic hydrocarbon-based solvent, a ketone-based solvent, an ether-based solvent, an acetate-based solvent, an amide-based solvent, γ -butyrolactone, an alcohol-based solvent, a silicon-based solvent, and mixtures thereof.

17. A method for forming interlayer insulating films between interconnecting layers of semiconductor devices, which comprises:

coating the composition of claim 1 on a substrate;

evaporating the solvent therefrom; and

heating the coating film at a temperature of 150~600°C under an inert gas atmosphere or vacuum conditions.

18. The method according to claim 16, wherein the coating is carried out by spin-coating at 1000~5000rpm.

19. A substance having nano-pores, said substance being prepared by the composition of claim 1.

20. A porous dielectric thin film produced from the composition of claim 1.

21. The porous dielectric thin film of claim 20 having a dielectric constant of 2.5 or less.